

The logo features the letters "NYS" in a bold, blue, sans-serif font. To the right of the text is a green circular graphic with a white grid pattern, resembling a stylized globe or a network. The background of the entire page is a light green with a large, faint, white grid pattern.

**NYS**

**SmartGrid  
Consortium**

## **Strategic Smart Grid Vision and Technical Plan Report**

*Leading the Way to New York's Future*

**DRAFT • August 21, 2009**





# Table of Contents

1	Executive Summary .....	1
2	New York State Smart Grid Consortium .....	9
2.1	Smart Grid Strategic Vision .....	9
2.2	Driving Forces of Change in Electric Power .....	11
2.3	Energy Policy Goals .....	12
2.4	Unique New York Resources .....	16
2.5	Consortium Model/Structure .....	18
2.6	Smart Grid Components .....	22
2.7	Smart Grid Benefits .....	23
2.8	Realizing the Strategic Smart Grid Vision .....	25
3	Accelerating Smart Grid Deployment .....	26
3.1	Objectives .....	26
3.2	Opportunities .....	27
3.3	Smart Grid Technical Plan .....	29
3.4	Federal Smart Grid Funding Opportunities .....	36
3.5	The New York Smart Grid Portfolio .....	40
3.6	Smart Grid Roadmap: Building Toward the Future .....	46
3.7	Project Manager Support .....	56
4	Ongoing development of the NY State Smart Grid .....	58
4.1	Roadmap for the Future .....	58
4.2	Strategic Mapping .....	58
4.3	Metrics and Allocation Process .....	60
4.4	Deployment of Technical Project Support .....	61
4.5	Nexus Development – R&D .....	61
4.6	Formalize the Consortium Structure .....	62
5	Conclusion .....	64
6	Appendix .....	65
6.1	Complete list of NYSERDA projects .....	65
6.2	Complete list of NYSTAR projects .....	67



# 1 Executive Summary

## New York State Smart Grid Consortium

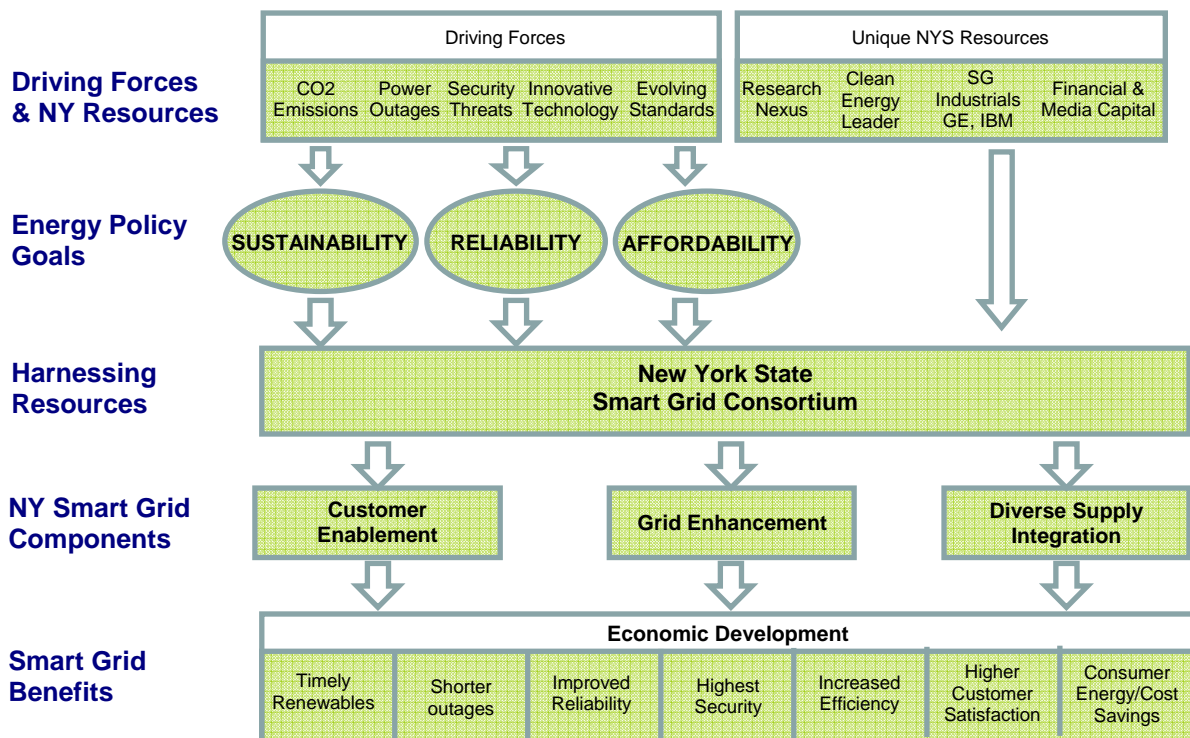
New York has a vision to facilitate a comprehensive, coordinated and collaborative approach that ensures an efficient, effective and secure smart grid implementation to meet the sustainable energy needs of all electric customers in the state.

New York's electric customers are served by six investor-owned utilities and several governmental entities, directly linked to three regional transmission organizations. New York is the domicile of key industrial smart grid players (IBM, GE), represents the nexus of major energy research facilities within academia, industry and government, is a leader in the use of clean energy (with a statewide renewable target of 25% by 2013) and is positioned to finance the infrastructure and communicate the smart grid story as the financial and media capital of the nation.

The purpose of the NYS Smart Grid Consortium, Inc. (a newly formed statewide energy collaborative) is to harness these unique resources to achieve its Strategic Smart Grid Vision and to serve as a model for the nation. This unique, collaborative approach will foster and accelerate the development of the smart grid and its three primary components, Customer Enablement, Grid Enhancement and Diverse Supply Integration.

This report is organized into three primary sections: [Section 2 \(New York State Smart Grid Consortium\)](#) provides an overview of the smart grid vision for New York State; [Section 3 \(Accelerating Smart Grid Deployment\)](#) describes how all of NY's stimulus proposals submitted under the Department of Energy's (DOE) smart grid funding solicitations complement one another and map to a common vision; and [Section 4 \(Ongoing Development of the New York State Smart Grid Consortium\)](#) outlines a strategy for the long-term engagement of the Consortium and the phased implementation of a comprehensive smart grid system.

## New York State Strategic Smart Grid Vision



The two primary objectives for implementing the smart grid are to promote economic development and improve customer satisfaction. Economic development is the overarching goal. Smart grid investments will help drive the formation and growth of “green” supplier companies and enhance the competitiveness of key cities. Improved reliability will help retain important companies and American jobs in the state. In the short term, smart grid economic development will be accelerated through Federal Stimulus Grants and Governor Paterson’s Jobs Plan.

The collective impact of the stimulus proposals identified in this report will be the creation of an estimated 3,200 jobs starting in 2010<sup>1</sup>. New York is focused on optimizing and coordinating the use of state, federal, and private funds to avoid any

<sup>1</sup> This jobs estimate assumes DOE funding of projects filed under two DOE funding opportunities (Smart Grid Investment Grants and the Smart Grid Demonstration Program). If some applications are not successful, job estimates will decline accordingly.



duplication of effort and maximize consumer value. Consortium members are committed to long-term economic growth and sustained job creation and respect the targeted purpose of the American Recovery and Reinvestment Act of 2009 (ARRA).

The New York State Smart Grid Consortium, Inc. ([www.nyssmartgrid.com](http://www.nyssmartgrid.com)) is a not-for-profit 501(c) 4 corporation. The Consortium was founded in 2008 when leaders determined that meaningful progress required the inclusion of all stakeholders to define and work toward a common vision. It is the only organization of its scale in the U.S. that is committed to representing all major contributors across the smart grid value chain; from utilities, market operators, industry, academia, government and end-users. Membership is based on commitment to a common set of Operating Principles:

- **Customer-focused** – Developing the most effective, efficient and accessible smart grid to benefit all customers and communities.
- **Strategically Aligned** – Building a robust, dynamic and secure electricity infrastructure by being collectively focused on the sustainable execution and progression of the NYS smart grid strategy.
- **Collaborative** – Integrating and leveraging the resources of the consortium membership - across industry, utility, market, academic and government institutions - to assure the open and effective development of shared institutional knowledge.
- **Innovative** – Managing a well-defined nexus of R&D smart grid technologies and systems to accelerate the advancement of technical and institutional interoperability.
- **Performance-driven** – Creating a transparent validation process to ensure the progression and long-term achievement of the NYS smart grid to foster economic development.



The combined strength of the Consortium strategically positions it at the focal point of the energy sector to effectively harness a unique set of academic, industrial, and commercial resources throughout New York State. Orchestrating these resources in a manner that satisfies critical policy goals for sustainability, reliability, and affordability is a key challenge for the Consortium. This collaborative format represents an innovative approach that has the potential to yield better collective results than would otherwise be achieved by individual company efforts.

## Accelerating Smart Grid Deployment

Building the smart grid in New York requires development and deployment of a Technical Smart Grid Plan that is mapped to a Strategic Smart Grid Vision. The ARRA provides a unique opportunity to accelerate this process and allocates \$4 billion through the Department of Energy (DOE) for smart grid initiatives. DOE's smart grid initiatives provide funding to match up to 50% of the project dollars invested by state, utility and other sources. Seeking both short term job creation and long term economic benefit, the DOE has created two programs to accelerate the modernization of the nation's electric power system in a manner that would leapfrog the country toward the smart grid of the future:

- Smart Grid Investment Grant Program (SGIG) -- DE-FOA-0000058.
- Smart Grid Demonstration Program (SGDP) – DE-FOA-0000036.

Successfully leveraging federal funds to accelerate the development of the NYS smart grid requires an evaluation of New York's Technical Smart Grid Plan to find synergies with the DOE stimulus grants.

**Technical Smart Grid Plan** – New York's Technical Plan is "to create a fully visible, integrated "smart" electricity system". Cyber security and standards compliance are key foundation elements. As outlined below, the Technical Plan describes what the smart grid will *deliver* in clear terms along five key dimensions.





- **Consumer Visibility to Energy Usage and Cost:** Consumers of all categories must have the ability to see the real-time costs of their energy choices.
- **Consumers Empowered to Save Energy Costs and Participate in Markets:** Consumers must be able to act directly or indirectly, on that usage and pricing information to make choices to save energy and money.
- **Utilities have Enhanced Visibility and Control of Distribution Systems for Reliability and Economics:** Utilities have the devices and communication systems in place to enable them to determine actual operational and economic conditions at any point, at any time.
- **Energy storage is used to improve economics and reliability:** Storage devices are integrated into the grid, to enable the most cost-effective management of generation and usage.
- **Transmission system reliability and economics are enhanced with smart grid technologies:** These are exploited to increase transmission utilization and support cost effective renewables integration.

**The NYS Smart Grid Stimulus Portfolio** – The complete NYS Smart Grid Project Portfolio consists of an array of initiatives underway, proposed and planned by a host of sponsors, as described more fully in [section 3.5](#). Most immediately, the Consortium's members have moved aggressively to take advantage of current DOE Smart Grid funding opportunities (see [section 3.4](#)). These proposed projects will propel New York significantly closer to realizing the Consortium's Technical Plan.

Sponsors in New York have proposed 30 stimulus projects in response to both of DOE's smart grid funding opportunity announcements totaling \$1.23 billion, which would create nearly 3,200 jobs. Investor owned utilities have proposed 22<sup>2</sup> projects for \$808.4 million. These projects have been reviewed by the New York State

<sup>2</sup> These totals include the two projects, totaling \$46.4 million, which are led by the NYISO but funded through the investor-owned utilities.



Department of Public Service. Based on this analysis, the Public Service Commission (PSC), on July 24, 2009, took unprecedented action to approve a tariff-based funding mechanism for the balance of the costs of these stimulus proposals. Contingent upon a funding award from DOE, this PSC action allows the utilities to collect 50 percent of the costs of projects through a surcharge mechanism.

Projects proposed by other sponsors have been reviewed by the appropriate state authorities. While the PSC action does not apply directly to them, it indicates a high degree of confidence in the customer benefits of smart grid and the likely support of state funding by New York. Governor David A. Paterson announced a Jobs Plan which complements the Federal Stimulus Awards. The efforts of the Governor, PSC, energy and research agencies of New York are aligned to support the work of the New York State Smart Grid Consortium.

In addition to these new proposed projects, New York State and the Consortium have a wealth of experience to draw upon in the form of existing and ongoing projects. 27 existing projects, representing \$120.7 million and 16 non-utility partners, have been funded through the New York State Energy Research and Development Authority (NYSERDA). New York academic institutions have an additional 29 projects funded or underway representing another \$11.6 million through 8 university partners.

The opportunity for near-term federal funding gave an immediate stimulus to the NYS Smart Grid Technical Plan. These 30 proposals constitute Phase I and zero in on virtually all of the critical technical and customer dimensions of the smart grid. Specifically, Phase I delivers significant progress in improved grid reliability, automation and control; system communications and in renewables integration. As discussed more fully in [section 3.3](#), Phase 1 projects tackle all five critical dimensions of smart grid functionality. To accelerate movement in specific technical areas, the Consortium has also identified specific demonstration projects designed to fill gaps in the project portfolio.





For example, the Consortium identified an opportunity to create a demonstration project – *Building to Grid and Market Integration* -- which includes New York City, NYPA, NYSERDA, NYISO, Viridity, IBM and Con Edison. This project will demonstrate dynamically adaptive models of building systems performance and energy utilization with co-optimization over time used to maximize demand response and dynamic pricing benefits. In this manner, over the next three years of their implementation, these Phase 1 projects will demonstrate the technologies and capabilities upon which the emerging smart grid depends.

Phase 2 projects will build on Phase 1 demonstrations and deployment activities, while focusing more on broadening deployment and full integration of these technologies into the seamless, intelligent, robust and reliable grid. The pace at which Phase 2 projects proceed will be dependent upon several variables, including regulatory support, the evolution of technology, and accumulating utility and customer experience. The Consortium will actively work with its members to identify future Phase 2 projects which reinforce and expand upon the 30 projects proposed under Phase 1.

**Project Management Support** – The project management team (KEMA and the DeSola Group) has provided a critical service in positioning the NYS Smart Grid Consortium to accelerate smart grid activity. It has facilitated the creation of the proposed *Building to Grid and Market Integration* demonstration and other demonstration projects described in section 3.6 to address high priority gaps in the Technical Plan. The team has assisted in the development of the Consortium structure, operating principles, and organizational identity. It has also created a communications strategy and is providing web and communications support to enhance the value of the Consortium's role and endorsement.

**Ongoing Development of the NY State Smart Grid** – The launch of the Consortium and filing of Smart Grid Stimulus Grant proposals has provided significant momentum for development of the New York smart grid. But there are significant start-up activities necessary to lay the foundation for future success. These activities include:



- **Strategic Mapping:** To help prioritize and guide the ongoing development of the New York smart grid.
- **Metrics and Public Benefits:** To develop important enabling processes for DOE metrics reporting, optimizing and coordinating state, federal, and private funds to maximize public benefit.
- **Deployment Technical Project Support:** To provide ongoing technical support and facilitate technical coordination and collaboration.
- **Nexus Development:** To position the Technology Nexus to harness and focus the research talent and resources of New York to achieve maximum benefit.
- **Formalization of the Consortium Structure:** To formalize the governance, structure and Operating Plan for the future.

## Conclusion

The shared commitment of the NYS Smart Grid Consortium, combined with the expertise, capabilities and resources of its members, positions New York State as a leader to successfully achieve its Smart Grid Vision. The anticipated DOE stimulus awards are a unique opportunity to accelerate the progress of smart grid deployment. The formalization of the Consortium through governance, Nexus development, communications and process will enhance its ability to successfully and collaboratively lead this important transformation. Governor David A. Paterson recently hailed the NYS Smart Grid Consortium as “the holistic model for public/private partnerships that we need to secure our sustainable energy future.” The time is now to deliver on that promise.

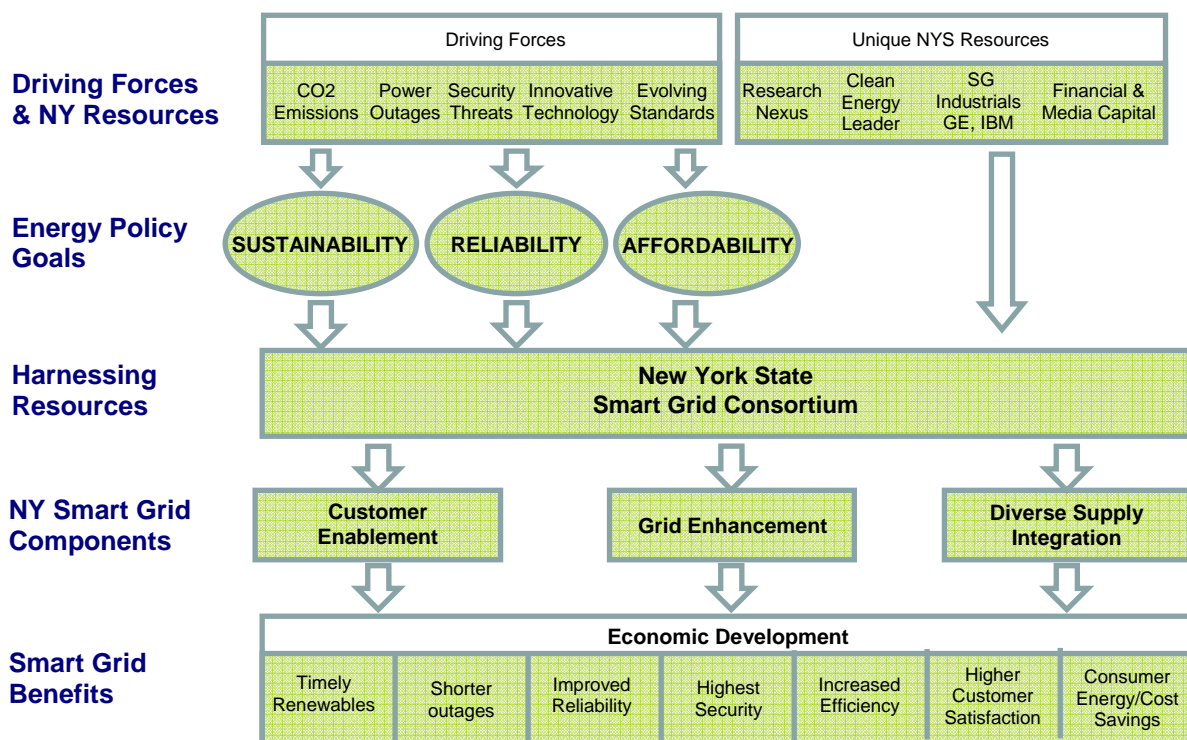
## 2 NYS Smart Grid Consortium

### 2.1 Smart Grid Strategic Vision

New York has a vision to facilitate a comprehensive, coordinated and collaborative approach that ensures an efficient, effective and secure smart grid implementation to meet the sustainable energy needs of all electric customers in the state.

The electric power supply and delivery system is being transformed by five driving forces – rising greenhouse gas emissions, power outages, security threats, innovative technology and evolving standards which will pace the dramatic change. This system is regulated by government because of its vital importance to the economy, our security and the daily lives of citizens. (The focus of this report is electricity, but subsequent analysis is required of other energy sources such as natural gas which are linked as both alternatives and sources of electricity.)

#### New York State Strategic Smart Grid Vision





New York has three primary state energy policy goals – sustainability, reliability and affordability. The objective of sustainability is to reduce the negative impact of fossil fuels on the environment which is reflected in New York's commitments to the Regional Greenhouse Gas Initiative (RGGI) and its own Renewable Portfolio Standard (RPS). Most reliability issues relate to local power outages, but occasionally disturbances (like the Blackout of 2003 which cost \$6-12 billion) spread across regions of the country. The Public Service Commission (PSC) and the New York State Reliability Council (NYSRC) work together to ensure electric system reliability. Affordability is the foundation of economic development. Historically, the PSC has determined fair prices for reliable and efficient electric power. A key to future affordability is the reduction of costly peak power production. The state has a unique wealth of intellectual, industrial and institutional resources focused on the development of the smart grid. New York's electric customers are served by six investor-owned utilities and several governmental entities, directly linked to three regional transmission organizations. New York is the domicile of key industrial smart grid players (IBM, GE), represents the nexus of major energy research facilities within academia, industry and government, is a leader in developing and deploying clean energy systems, and is positioned to finance the infrastructure and communicate the smart grid story as the financial and media capital of the nation.

The purpose of the NYS Smart Grid Consortium is to harness these unique assets to address the state's energy policy goals, achieve its Strategic Smart Grid Vision and serve as a model for the nation. This unique, collaborative approach will foster and accelerate the development of the smart grid and its three primary components, Customer Enablement, Grid Enhancement and Diverse Supply Integration. The ongoing Consortium process will help focus effective implementation, and promote economic development as an overarching goal. Smart grid investments will help drive the formation and growth of "green" supplier companies and enhance the competitiveness of key cities. Improved reliability will help retain important companies and American jobs in the state. In the short term, smart grid economic development will be accelerated through Federal Stimulus Grants and Governor Paterson's Jobs Plan. Satisfying customer needs is the common theme of all smart grid benefits. The ongoing Consortium process will



result in higher levels of customer satisfaction, improved reliability, shorter outages, increased efficiency, customer energy/cost savings, the highest levels of security and a timely incorporation of renewable energy.

## 2.2 Driving Forces of Change in Electric Power

New York and the country are addressing electric power system challenges today, in order to shape a more sustainably and economically vibrant future. This is a topic that has been extensively researched and documented. The objective here is simply to acknowledge the five forces driving dramatic change:

- *Rising Greenhouse Gas Emissions* (CO<sub>2</sub>) have the potential to seriously impact the environment and local economies.
- *Power Outages* wreak havoc and cost billions of dollars in lost productivity and revenue. The 2003 Blackout was the defining event that underscored the economic imperative to improve reliability.
- *Security Threats* are constant to the electric infrastructure. The physical and cyber security risks from terrorists and hackers continues to grow exponentially
- *Innovative Technology* holds significant promise as a “game changer.” Innovation is pervasive across the electricity value chain (from smart appliances to advanced energy storage technologies).
- *Evolving Standards* hold the key to the pace of development. Technical interoperability will be vital to ease of use, adoption rates, cyber security and avoiding stranded costs. The National Institute of Standards and Technology ([NIST](#)) is developing these standards in conjunction with the GridWise Architecture Council ([GWAC](#)).



## 2.3 Energy Policy Goals

New York State has three primary electric energy policy goals - sustainability, reliability and affordability which are being driven by the forces of change identified above. But it is the direction and magnitude of resources committed to achieve these policy goals that establish New York as a clear electric power leader in the nation:

**Sustainability** – New York State has just released its [2009 State Energy Plan \(SEP\)](#) for public comment. This SEP reinforces the state's commitment to achieving the Renewable Portfolio Standard (RPS) targets. The goal of this initiative is to increase the proportion of renewable energy used by New York consumers to 25% in 2013. For more information, please see the [2009 RPS Program Evaluation Report](#).

As part of its order, the Commission designated NYSERDA as the central procurement administrator for the RPS Program and directed investor-owned utilities to collect funds from ratepayers to support these efforts. Renewable energy sources such as wind and solar produce electricity on an intermittent basis and there are practical and technical challenges to safely and efficiently incorporate these systems within the electric grid. A [NYSERDA study](#) exploring the transmission reliability issues associated with wind energy is an instructive example.

NYSERDA has pursued a two-tiered development approach under the RPS program targeting both Main Tier Generation (medium to large scale generators who sell into the wholesale power market administered by NYISO) and a Customer-Sited Tier (smaller “behind the meter” resources that produce electricity for use on site). By the end of 2009, 1338 MW of new wind, hydro and biomass generation will have been created from Main Tier sources. An additional 12 MW of capacity is targeted by 2009 from the Customer-Sited Tier based on Solar, Fuel Cells, Biogas and Small Wind. A net-metering provision currently exists in New York to facilitate interconnection of customer-sited renewable energy systems.





In 2003, New York Governor Pataki sent a letter to northeastern governors urging them to “develop a strategy to help the region lead the nation in the effort to fight global climate change.” After years of review and negotiations, New York was joined by nine other states in the Regional Greenhouse Gas Initiative (RGGI). RGGI is designed to leverage existing efficiency programs to achieve additional efficiency and reduce greenhouse gas emissions. Cap and Trade auctions began in late 2008 and the first three-year compliance period began in January 2009.

The [New York RGGI Operating Plan](#) was reviewed by an independent multi-disciplinary advisory group and adopted by the Board of NYSERDA which serves as administrator of the program. Its initial three-year goals for New York are to reduce customer bills by over \$1 billion, oil imports by 6.5 million barrels, greenhouse gas emissions by 8.3 million tons and create “green collar” jobs. Electric Power Supply is one of the five major areas of focus in the Operating Plan with a 20% share of the projected \$525 million three-year budget (based on a \$3 per ton CO<sub>2</sub> clearing price). The plan targets \$27 million for smart grid and \$17 million for strategic R&D investments over the next three years.

[The Clean Air Interstate Rule \(CAIR\) program](#) has raised \$25 million from NO<sub>x</sub> and SO<sub>x</sub> emission trading advances to support the New York Battery and Energy Storage (NY BEST) initiative. NY BEST is focused on developing energy storage technologies in support of both transportation and stationary applications. The NYS Smart Grid Consortium will coordinate with NY BEST to promote the development of energy storage technologies for improving the performance of the electric transmission and distribution (T&D) system.

**Reliability** – Most reliability issues relate to local power outages, but occasionally disturbances spread across regions of the country. The 2003 blackout underscored the ongoing importance of electric reliability programs that have been progressively developed following the New York City blackout of 1965. The Northeast Power Coordination Council sets regional standards for New York, New England and eastern Canada. In order to voluntarily coordinate policies and operating protocols for the entire system, the North American Electric Reliability Council (NERC) was formed as an association of all the regional entities in 1968. In 1977 New York



became one of the first states to create 99 mandatory standards for the electric power system which became the foundation for NERC policies. The Energy Policy Act of 2005 transformed national voluntary standards into mandatory standards under the jurisdiction of the Federal Energy Regulatory Commission (FERC) which has the authority to fine utilities for violations.

Prior to deregulation of the electricity markets the New York Power Pool managed bulk power in the state. It has since been transformed into the New York Independent System Operator (NYISO) which oversees the reliable operation of the bulk power system for the state and operates the wholesale electric power market. Its activities are independently monitored by the New York State Reliability Council (NYSRC).

NYSRC was approved by FERC in 1998 and founded in 1999. NYSRC has three major activities - it develops reliability rules, assesses compliance with the reliability rules (in conjunction with NYISO) and defines statewide installed capacity requirement (e.g. the need to maintain 116.5% of expected peak load demand as a reserve margin). The PSC has adopted NYSRC policies as mandatory for utilities in the state. A major focus of NYSRC's efforts in the past few years has been to incorporate wind generation, an intermittent renewable resource, safely into the power grid.

**Affordability** – Energy affordability supports economic development and improves the competitive advantage of local businesses. Historically, the PSC has determined fair prices for reliable, efficient electric power. The PSC regulates utilities to ensure that the electric power system provides a reliable, high quality flow of energy to residential, industrial and commercial customers at an affordable price. The rate making process focuses on allowable investments and rates of return for investor owned utilities. The PSC is especially conscious of costs because New York already experiences very high electric utility costs (15 cents per KWh) which is nearly double the national average. Prices for state and municipal utilities are governed by the New York Power Authority which has similar affordability goals and provides low cost power to support economic development activities across the state.

A key to future affordability is the reduction of costly peak power production. Major efforts are being made to address peak power consumption through dynamic pricing



signals and demand response programs. Pricing has the potential to influence customer behavior by signaling the true economic costs involved. However, currently enacted legislation prohibits the use of real time / variable pricing for residential customers in order to protect them from spikes such as experienced in California.

NYSERDA has funding under the System Benefits Charge (SBC) program to evaluate dynamic pricing as a method to reduce energy consumption and costs for consumers. Its demand-response and dynamic rate research program promotes cost effective ways to empower NYS electric consumers to become more active participants in the electric grid and market. Smart grid/AMI deployments and this program share the common objectives of providing consumers with choice and flexibility. Demand response programs have the ability to selectively cut peak demand. These have been successfully pursued by NYISO at the wholesale level for over ten years, with 7.5% of peak capacity currently enrolled. Over 50% of New York's housing stock is multi-family and is a prime opportunity for demand response enabled by smart grid. NYSERDA is currently piloting a mini-smart grid in nearly 1000 multi-family homes.

New York also has focused on conservation to reduce costs for its consumers. Energy Efficiency Programs to help both commercial and residential customers help identify inefficiencies and potential solutions. These programs are funded by the state and are administered by major utilities throughout New York. The goal is a 15% reduction in electricity consumption by 2015 which represents the most aggressive target in the nation.

In addition to conservation, the PSC is interested in reducing system power losses within the context of smart grid. NYSERDA is funding a project through its smart grid T&D R&D program that will place all utility loss filings on a common basis to help assess and attack the root causes of power losses.



## 2.4 Unique New York Resources

New York has four important resources that uniquely position it as a leader in smart grid development:

**Domicile of Major Industrial Smart Grid Players** – New York is the domicile of major industrial companies committed to developing the smart grid. GE is a primary manufacturer of generators (including wind turbines), transformers, relays, power electronics, power system automation equipment, and smart appliances. IBM is a major provider of systems hardware and software for the energy sector. As such it is well positioned for the massive systems integration required to make the smart grid operational. The combined resources and expertise of these two companies are significant assets for New York. Combined with other major New York companies such as Verizon, these companies provide a skilled smart grid workforce which is unmatched by any other state.

**Nexus of Electric Energy Research** - A Nexus of major electric energy research facilities (academic, industrial and government) in New York provides the intellectual capital to lead the national development of the smart grid. New York is the home of five DOE Energy Frontier Research Centers (EFRCs) at Brookhaven National Laboratory, Columbia, Cornell, GE Global Research and SUNY Stony Brook. Both GE and IBM have R&D facilities headquartered in the state. Over a half billion dollars of projects and programs have been funded by NYSTAR and NYSERDA over the past decade. Long Island is home to the Brookhaven National Laboratory which is a leading center of electric power research. A host of prestigious academic institutions (Cornell, Columbia, Syracuse, AERTC at Stony Brook) have pioneered over 90 recent or current energy research projects. RGGI funding identified for targeted R&D technology centers will provide the magnet to significantly advance the prominence of New York's technology nexus. The nexus will focus on four areas, power electronics, advanced materials, energy storage and systems integration, where New York is positioned to be a national R&D leader.



**Clean Energy Leader** – The state is a clean energy leader in the nation. As the originator and a leader of the RGGI, it has recently added over 1300 MW of wind, hydro and biomass generation and already provides 20% of its electricity from renewables. It is also a leader in providing energy efficiency and demand response programs for end use consumers. NYSERDA is a recognized national leader in administering these programs and charting a sustainable energy future. A recent report, prepared by the New York Academy of Sciences entitled [“Innovation and Clean Technology in NYS” \(May 2009\)](#) identified NY technical expertise in five key areas representing a broad range of “clean tech” capability – buildings, biomass, storage, PV, and smart grid.

**Financial and Media Capital** – New York City is the financial and media capital of the nation. The combined resources and expertise of commercial and investment banks plus insurance companies domiciled in New York will play a vital role in financing and insuring the billions of dollars of infrastructure investment needed for a 21<sup>st</sup> century smart grid. One of the major challenges for the smart grid is customer education and adoption rates. New York City is the broadcast media capital of the nation. It is in the ideal position to assess and communicate the opportunities embodied in the Smart grid which should promote understanding and acceptance adoption by customers throughout the nation.



## 2.5 Consortium Model/Structure

The New York State Smart Grid Consortium has been operating since 2008 and was incorporated in 2009 as a not-for-profit, 501(c) 4 corporation to harness the unique resources of the state as it manages the collaborative development of the smart grid. The Consortium represents a key public / private partnership to promote broad statewide implementation of the smart grid.

**Objective** – To benefit customers by promoting sustained economic development opportunities and improved performance of the electric power supply and delivery system through smart grid technology development and implementation.

**Membership** – The NYS Smart Grid Consortium is the only organization of its scale in the U.S. that represents all major leaders across the energy value chain. Seven sectors are represented as follows: Generators, Electric Utilities, Markets, End-Use, Government, Industry, and Universities.

**Operating Principles** – Membership is based on embracing a common set of Operating Principles:

- **Customer-focused:** Developing the most effective, efficient and accessible smart grid to benefit all customers and communities.
- **Strategically Aligned:** Building a robust, dynamic and secure electricity infrastructure by being collectively focused on the sustainable execution and progression of the NYS smart grid strategy.
- **Collaborative:** Integrating and leveraging the resources of the consortium membership - across industry, utility, market, academic and government institutions - to assure the open and effective development of shared institutional knowledge.
- **Innovative:** Managing a well-defined nexus of R&D smart grid technologies and systems to accelerate the advancement of technical and institutional interoperability.
- **Performance-driven:** Creating a transparent validation process to ensure the progression and long-term achievement of the NYS smart grid to foster economic development.





**Governance** – The Consortium is governed by a Board designed to represent each portion of the value chain. The founding Board has a process to admit new members and complete the Board membership. Consortium members will meet quarterly, with most of the work completed in established working groups. Transitional administration is being provided by NYSERDA and NYSTAR pending the hiring of an Executive Director and staff.

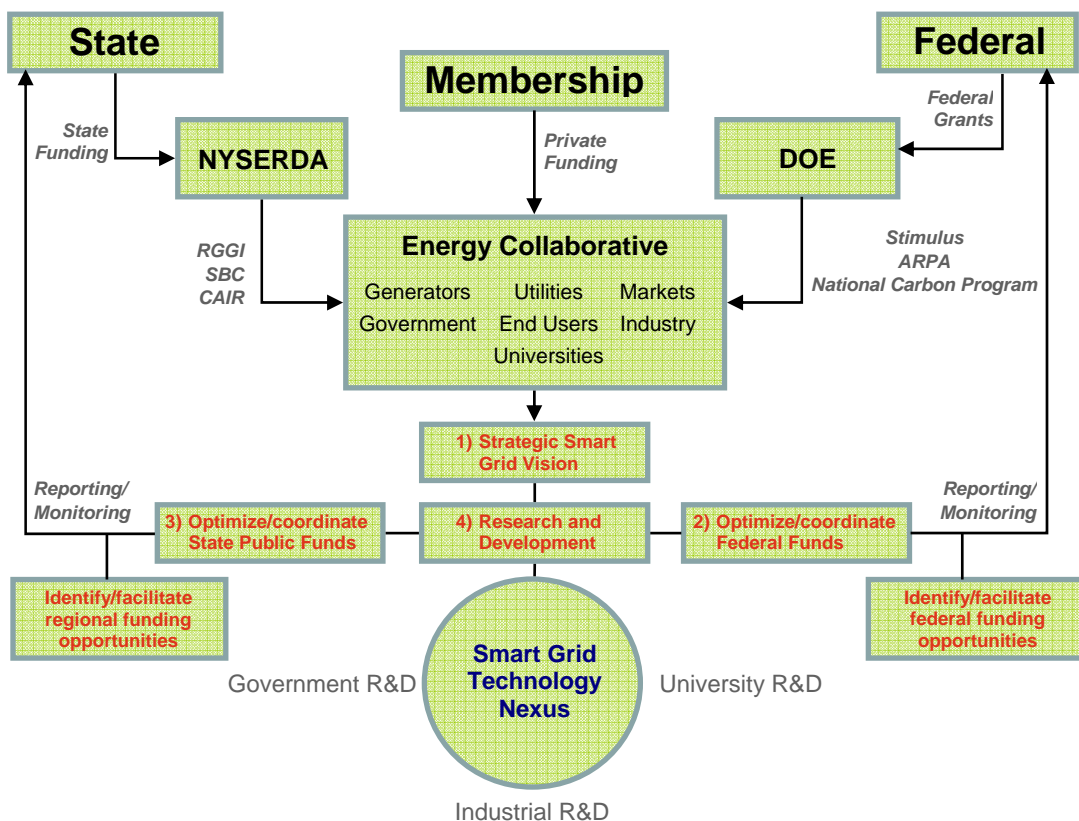
In addition to the DOE's stimulus funding opportunities, NYS has also committed resources to promote implementation of the smart grid. The Operating Plan for RGGI includes a total of \$27 million to support an Advanced Power Delivery Program over a three-year period. Aligning these funds in a manner which further leverages federal resources is a key goal of the Consortium. RGGI funding has also been allocated to investigate the impact of solar photovoltaic systems on utility distribution systems (\$6 million over three years) and to establish one or two Clean Energy Research Centers focused on critical energy technologies such as electric energy storage, power electronics, and smart grid systems integration (\$17 million over three years).

A NYS stimulus matching grant program has also been established to further reinforce long-term economic benefits. NYSTAR will administer this program and a total of \$10 million has been allocated for qualifying smart grid investments.

One of the critical responsibilities of the Consortium will be to develop an effective process for using these state funds – in a manner consistent with pre-defined policy goals – to significantly improve overall reliability, sustainability, and affordability of the electric power supply and delivery system. The Consortium's members represent all components of the energy value chain and a fully transparent process shall be established to provide maximum value for consumers.

The Consortium framework is depicted in the following figure and illustrates how state, federal, and private membership funds will be co-optimized. This public/private partnership is unique and will nurture innovation and technology commercialization. All Consortium members maintain equal stature and secure an opportunity to demonstrate their commitment to realizing statewide public benefits.

## NYS Smart Grid Consortium Framework



The Consortium will play a critical role in fostering the development of a smart grid technology nexus that positions NYS to become a national “hub” and leader in this area. The structure and framework of the Consortium are intended to focus the R&D initiatives of government, industry, and universities and set the stage for accelerating the pace of innovation. The Consortium will focus R&D activities on advanced products and applications that are commercially-focused and targeted to address real-world problems.



The Consortium will focus on ten primary tasks as follows:

1. Develop and update the Smart Grid Vision.
2. Define the technical specifications of smart grid systems to better focus R&D activities.
3. Position NY to be the R&D nexus for smart grid technology commercialization.
4. Facilitate industry-university-utility partnerships that promote collaboration and increase the pace of innovation and deployment.
5. Aggregate all of NY's smart grid stimulus project metrics into a common set of public benefits.
6. Identify all current and future funding opportunities that best leverage state resources.
7. Communicate benefits to customers in a simple and effective manner.
8. Organize technical conferences to educate consortium members, regulators, policy makers, and public officials about smart grid technologies.
9. Promote information exchange with all Consortium members to avoid any duplication of effort.
10. Pro-actively engage the federal/state government – as an organization representing the entire electric power supply and delivery chain – to influence smart grid legislation.

The Consortium will be organized into four distinct groups focusing on strategic planning, communications, research, and policy. Member Working Groups will be formed within each group to address all ten primary tasks.



## 2.6 Smart Grid Components

The New York smart grid will be built upon three key components, Customer Enablement, Grid Enhancements and Diverse Supply Integration:

**Customer Enablement** – Enabling the customer represents an important aspect of developing the New York State smart grid. Providing the customer with adequate and timely information and options will encourage them to make informed decisions. The options will come in the form of pricing that more closely reflects the cost to deliver energy (Demand Response, time of day, variable), simple, interoperable equipment (AMI, smart devices, DG, storage, PHEV) and network automation to manage their energy costs. These decisions will benefit customers and be aligned with state energy policy goals. In essence, the customer becomes an active participant within the grid instead of being a passive user of electric services.

**Grid Enhancements** – The grid connects the customer to generation, transmission and distribution in the electric power system. As the aging infrastructure is upgraded, it will provide significant opportunities to improve cost and reliability through advanced sensors and controls (e.g. PMU) designed to limit outages (self-healing, islanding), linked by integrated communications networks and managed by coordinated systems and operations. As grid enhancements provide a reliable supply of electricity at reasonable costs, they elevate security risks (cyber and physical) and the importance of managing them. Standards which are being developed by NIST with support from the GridWise Architecture Council will enable the safe and efficient operation of the smart grid.

**Diverse Supply Integration** – The energy supply portfolio will continue to evolve and several newer types of generation (wind, solar) tend to be intermittent and less predictable. Incorporation of renewable energy sources into the electric power grid will require a combination of solutions including storage, demand response, transient mitigation and advanced analytics. This integration will facilitate a more timely achievement of renewable portfolio standards.



## 2.7 Smart Grid Benefits

The two primary objectives of smart grid are economic development and customer satisfaction. Economic development is the overarching goal. Smart grid investments will help drive the formation and growth of “green” supplier companies and enhance the competitiveness of key cities. Improved reliability will help retain important companies and American jobs in the state. In the short term, smart grid economic development will be accelerated through Federal Stimulus Grants and Governor Paterson’s Jobs Plan. The collective impact of these proposals by Consortium members will be the creation of 3,200 jobs.

**Economic Development** – The overarching benefit of the New York smart grid is Economic Development:

- **New Jobs:** The manufacture, installation, operation and maintenance of the smart grid and its components will create new jobs within the state.
- **Innovation:** Research has been the hallmark and economic engine of New York for over two centuries. Smart grid innovation will enable the growth of business while rewarding customers with valuable new products.
- **Lower Costs:** Costs rise over time and energy is no exception. But the smart grid should provide energy at a lower future cost than otherwise would be possible. As such, it will save customers money which can be invested or consumed as they choose.

### Customer Benefits

Satisfying customer needs is the common theme of all other smart grid benefits. The ongoing Consortium process will result in higher levels of customer satisfaction, improved reliability, shorter outages, increased efficiency, customer energy/cost savings, the highest levels of security and a timely incorporation of renewable energy.



- **Higher Customer Satisfaction:** The combination of lower costs, improved reliability and better customer control will raise satisfaction among all types of customers (residential, commercial, industrial, institutional).
- **Improved Reliability:** The Advanced Transmission Operations (ATO) and Advanced Distribution Operations (ADO) inherent in the smart grid will reduce and shorten outages and improve the quality of power.
- **Shorter Outages:** The incorporation of advanced sensors and measurement (PMU), communication networks and smart systems will allow an unprecedented degree of system visibility and situational awareness of the electric power system. Smart grid will result in shorter outages through its “islanding” and “self-healing” features.
- **Increased Efficiency:** The integrated advanced components of the smart grid will improve efficiency and lower costs for customers.
- **Customer Energy/Cost Savings:** As pricing becomes more transparent and is aligned with the underlying economics of generation and distribution, customers’ decisions to save money will benefit society as well.
- **Highest Security:** Security will be incorporated into the design of the smart grid and will require the implementation of practices and procedures by individual stakeholders. In this way, the physical and cyber security risks can be managed to the highest standards possible.
- **Timely renewables:** Smart grid is the enabler of more renewable energy. Its development will allow for the timely incorporation of these sustainable sources of power in a user-friendly, cost effective manner.





## 2.8 Realizing the Strategic Smart Grid Vision

The shared commitment, combined with the expertise, capabilities and resources of its members, positions New York State as a leader to successfully deliver on its Strategic Smart Grid Vision. Governor Paterson hailed the New York State Smart Grid Consortium as “the holistic model for public/private partnerships that we need to secure our sustainable energy future.”

The following sections of this report review:

- The potential to accelerate progress through the Department of Energy Smart Grid Stimulus Grants.
- The ongoing development of the smart grid management process.



## 3 Accelerating Smart Grid Deployment

Accelerating implementation of New York's smart grid requires a consistent and dedicated focus on both the technical and organizational aspects of the Consortium's Strategic Vision. This section describes the objectives of this acceleration and the opportunity presented by the current DOE Smart Grid funding opportunities. We will also describe the manner in which the Consortium's Technical Plan, in combination with the project review and development processes utilized in this current round, will continue to guide this effort into the future. Through this focused collaboration, smart grid implementation in New York will receive a level of dedicated technical and strategic oversight commensurate with the scale and importance of the transformational effort.

### 3.1 Objectives

Transforming New York's electricity grid represents a huge investment of public and private funds. As such, public benefits of equal scale are expected to result. The Consortium's overall objective for New York is:

*To create as many jobs as possible—both direct and indirect—while facilitating the transformation of the State's electric energy system.*

To achieve this objective it has focused on two things:

- **High New York Success Rate** – ensuring that New York smart grid stimulus applications have a commitment from the state for matching funds prior to submittal and benefit from Consortium communications and relationships.
- **Consortium Alignment** – collaboratively reviewing all applications to ensure they are aligned with the Strategic Smart Grid Vision and Technical Plan, leverage the unique resources of New York, capture potential synergies and are committed to share learning as outlined in the Consortium's Operating Principles.



## 3.2 Opportunities

### Federal Funding Opportunities

The *American Recovery and Reinvestment Act of 2009 (ARRA)* provides a unique opportunity to accelerate this process of transforming our nation's electric power supply and delivery system. ARRA allocates \$787 billion to stimulate the economy and create jobs. The Act gives preference to activities that can be started and completed expeditiously. Of the total, \$4.2 billion will be provided through the DOE for smart grid initiatives. This amount will match up to 50%, the dollars provided by state and other sources. Seeking both short and long term economic benefit, the DOE has created two programs to accelerate the modernization of the nation's electric power system in a manner that would leapfrog the country toward the smart grid of the future:

- Smart Grid Investment Grant Program (SGIG) -- DE-FOA-0000058.
- Smart Grid Demonstration Program (SGDP) – DE-FOA-0000036.

As reinforced below, the Consortium seeks to reap maximum leverage from these federal funding opportunities. This process begins an evaluation of proposed New York smart grid projects against two sets of criteria – those defined by DOE and proposed within the funding solicitations, and those explicit in the Consortium's Smart Grid Technical Plan ([next section](#)). This analysis helps identify strengths, overlaps and synergies as well as portfolio gaps and short-comings, all of which have informed the Consortium's subsequent efforts.

### New York's Own Opportunities

As discussed in [section 2.4](#), New York has a wealth of resources to bring to this effort to accelerate the State's smart grid transformation. Significant challenges need to be addressed during the smart grid transition:



- **Regional diversity:** New York State has every type of geography and community characteristic imaginable, from extremely rural, suburban and semi-rural communities, to high-rise urban towers and large urban concentrations. Each of these environments provides a test-bed for different smart grid technologies and applications.
- **Above-average electricity rates:** New York State's electricity costs are almost double the national average. The economic benefits of greater system efficiency are urgently sought by customer, regulator and utility operator alike.
- **Aging infrastructure:** Replacing the mechanical systems of NY's aging network with smart devices – that, for example, sense system conditions, communicate in real-time, and take immediate action to isolate problems and maintain reliability -- provides an immediate reliability benefit to the entire system.
- **Transmission congestion:** High demand, dense populations and constrained transmission creates fragility in a system that must be robust. NYS leads in the integration of renewable generation, yet these intermittent resources create additional grid management challenges.
- **Urban underground networks:** The underground distribution networks of urban New York City are aging, invisible to grid managers and difficult to repair. The challenge of maintaining these systems is exceeded only by the benefit of upgrading them with smart, self-monitoring and self-healing technologies.
- **History of power outages, service challenges:** Like many regions of the country, New York State has seen both localized and widespread outages and service losses. The track record of black-outs, brown-outs, service issues and other maintenance and operational challenges testifies to the immediate reliability benefits available through the smart grid transition.



### 3.3 Smart Grid Technical Plan

To accelerate a technology-based transformation, it is vital to have a clear and robust understanding of the desired outcomes. The following matrix summarizes the five functional dimensions of the smart grid, as articulated by the Consortium in its Technical Plan – that of a fully visible, integrated “smart” electricity system.

These five dimensions of smart grid functioning are:

- **Consumer Visibility to Energy Usage and Cost:** Consumers of all categories must have the ability to see the real-time costs of their energy choices.
- **Consumers Empowered to Save Energy Costs and Participate in Markets:** Consumers must be able to act on that usage and pricing information, to make choices to save energy and money.
- **Utilities have Visibility and Control of Distribution Systems for Reliability and Economics:** Utilities have the devices and communications systems in place to enable them to determine actual operational and economic conditions at any point, at any time.
- **Energy Storage is used to Improve Economics and Reliability:** Storage devices are integrated into the grid, to enable the most cost-effective management of generation and usage.
- **Transmission System Reliability and Economics:** Economics are enhanced with smart grid technologies. These are exploited to increase transmission utilization and support renewables integration.

As further summarized below, implementation of the Smart Grid Technical Plan is already underway. All of the projects identified in this report represent significant steps toward the full smart grid transformation. The transformation will occur over time in a phased manner, and proposed Phase I projects under DOE FOA 58 and 36 provide the necessary support to get started.



The projects proposed under FOA 58 and 36 represent a base of critical technologies and systems essential to the New York State Smart Grid vision. As noted above, New York poses unique challenges in the wide range of environments and associated infrastructure needs which must be addressed. Phase 1 projects will speed New York State's progress toward the Smart Grid by:

- **Deploying 'smart' technologies in all types of conditions** - Upstate New York has many square miles of low density rural and mountainous terrain with aging T&D infrastructure. These areas require basic modernization with distribution automation and control systems in order to take advantage of smart grid technologies such as AMI and behind the meter Home Automation. These needs are addressed in the various utility T&D automation and control system projects.
- **Enabling energy efficiency, demand response and dynamic pricing** - In the major urban areas, especially the New York City metropolitan area, the State, City, and utilities already have aggressive energy efficiency and demand response programs in place for high rise office and apartment buildings. The smart grid challenge is to couple new automation technologies for the underground network and advanced Building to Grid technologies to take demand response to a new level and enable a voluntary dynamic pricing regime to build public support for a new concept.
- **Speeding the addition of automation and control** - The underground distribution network in New York City poses technological difficulties in distribution automation, sensing, and control that are not addressed by "mainstream" smart grid technologies aimed at the U.S. predominantly overhead radial distribution systems. The demonstration projects proposed by Con Edison in particular address these issues in multiple ways. The demonstration project proposed by New York City, NYPA, and the NYISO for advanced Building to Grid will address the demand response and dynamic pricing in the urban high rise environment with new technologies and optimization paradigms.





- **Making the grid more ‘renewables-friendly’** - New York faces challenges in renewable resource development, as upstate wind generation is constrained from reaching downstate load centers. Beyond the familiar problems of transmission congestion created by insufficient transmission capacity to transport a new remote resource, New York additionally faces the challenge of its location in the loop around the Great Lakes which is a well known transmission loop flow and stability concern. The regional synchrophasor and shunt capacitor projects will enhance the visibility and monitoring of the state grid, enable the NYISO to develop new algorithms for grid stability monitoring and control, and will reduce transmission losses and improve grid voltage stability.
- **Accelerating the demonstration of energy storage systems** - The requirement to balance intermittent renewable generation has also presented an opportunity for storage projects. The large Compressed Air Energy Storage (CAES) project proposed by Energy East will add to the state's ability to integrate large wind resources by assisting in diurnal shifting of wind energy. This project, plus additional storage demonstrations proposed by Con Edison and LIPA/ SUNY-Stony Brook and four more storage-related projects at CCNY, will give the Consortium a wealth of experience to cross-fertilize among all Consortium participants.
- **Accelerating “Building-To-Grid” implementation** - The Consortium Building to Grid demonstration project will put in place the platform of systems, communications, and protocols which will support additional commercial and government facilities. The energy savings and occupancy benefits demonstrated in this project will serve to attract additional real estate operators and agencies to join the program. The savings from demand response and energy efficiency gained by an organic expansion of B2G from this program are anticipated to gain the state considerable breathing room in terms of renewables integration, peak demand and related capacity needs and costs, and even the ongoing upgrades of the underground distribution network as the B2G can be used to alleviate local network problems. This breathing space will enable the state utilities to make



further progress on the Smart Grid Vision as pressure on basic infrastructure needs are relieved.

- **Increasing control of the underground network** - The demonstration of Fault Current Limiters by Con Edison will lead to increased controllability of the underground network and in time more flexibility in how it is operated and managed in conjunction with the transmission system. Deployment of Fault-Current Limiters with rapid response capabilities allows for a greater penetration of efficient distributed generation resources on the distribution system.
- **Accelerating implementation of synchrophasors** - The Nexus of NY universities will be able to provide support to the NYISO in development of new applications that exploit the synchrophasor systems to optimize grid operations and renewable integration without compromising reliability. The involvement of the universities in the first synchrophasor projects will lead to ongoing involvement in research and pilot projects that in turn lead to commercial operation at the NYISO.
- **Increasing the integration of renewables** - The successful demonstration of the dynamic thermal circuit rating technologies by NYPA (see project description in section 3.6), followed by validation of the benefits to markets and operations by the NYISO, will lead to widespread implementation and increased transmission capacities upstate in support of renewables. A sound demonstration and validation is essential to the incorporation of dynamic ratings into grid operations and congestion management and this project will enable that.
- **Enabling the integration of PHEVs** - The New York City metropolitan area is forecast to be one of the 2 or 3 areas in the country where Pluggable Hybrid Electric Vehicles (PHEVs) and Electric Vehicles (EVs) will reach significant penetration in the next few years. That penetration, coupled with the widespread use of parking garages as opposed to residential single family garages in the city, will create challenges and opportunities for PHEV and EV integration. Phase 1 and 2 projects that improve grid visibility and control as



well as the B2G project create a platform that can be exploited to support PHEV and EV integration. Experience gained in the University of Buffalo PHEV grid-impact study, now underway, will also feed into these projects.

- **Anticipating new storage technologies** - The Consortium will support renewables and EV development thanks to the presence of the NY BEST as well as the ongoing wind integration research and development at Cornell and at GE. For instance, GE has recently announced a new "wind inertia" technology that aids in replacing lost frequency response as high RPS levels replace rotating generation with inverter based generation. This technology can be demonstrated on wind facilities in New York and its benefits validated via the new synchrophasor systems as a follow-on to the current demonstration and investment grant proposals in future years.

In short, Phase 1 projects – and the Phase 2 projects that will follow from them – will build an assemblage of statewide R&D capabilities among all Consortium members. The NYS Smart Grid Consortium will create a virtuous circle of development, demonstration, benefits realization, and subsequent follow-on new R&D, development and deployment across the State for many years to come.

The following chart summarizes the progress toward this vision being made under the Consortium's umbrella. The chart highlights the five key dimensions or technical tasks of smart grid development. For each of these key smart grid dimensions, we list the status of projects in the current portfolio (Phase 1). Assuming these projects receive federal support, implementation of Phase 1 projects is expected to initiate upon award (in 2010) and continue through 2013.

The tasks shown for Phase 2 help identify the work ahead – these are the steps to be taken in future projects, as precursors to and steps toward the ultimate Smart Grid Technical Plan.



Smart Grid Dimension	Phase 1	Phase 2	Ultimate Vision
<b>1. Consumer Visibility to Energy Usage and Cost</b>	Several AMI Projects with In-home displays will provide consumers with energy usage and cost data	Full roll out of AMI technologies across the state	Advanced consumer information technologies will not only provide usage and cost information but decision support on cost reduction approaches
<b>2. Consumers Empowered to Save Energy Costs and Participate in Markets</b>	Automatic energy saving devices such as smart thermostats are deployed in several projects. Voluntary response to dynamic pricing is enabled by rebate programs.	Autonomous energy saving devices are prevalent and additional dynamic pricing opportunities for customers evolve. Advanced demand response interacts with consumer smart devices.	The NYISO has developed methodologies for incorporating consumer price elasticity into markets and operations
	Advanced building automation and Building to Grid (B2G) systems are demonstrated in Manhattan with NYC and other landmark buildings. Market integration with the NYISO provides advanced demand response and dynamic pricing. Advanced DR is integrated with Con Edison underground network operations to enhance reliability	B2G becomes widespread in NYC and other New York Cities and commercial developments. B2G participates in demand response and dynamic pricing as well as annual capacity auctions.	B2G becomes an energy saving standard, integrated with NY energy efficiency programs.



Smart Grid Dimension	Phase 1	Phase 2	Ultimate Vision
3. Utilities have Visibility and Control of Distribution Systems for Reliability and Economics	Several Distribution Automation Projects including advanced smart grid technologies are launched. Con Edison demonstrates advanced "system of systems" integration for vastly enhanced visibility and control. Distributed renewable resources are included in these projects. Use of Fault Current Limiters on the underground network is pioneered.	Full Distribution Automation with enhancements for distributed renewables resources integration is the norm in NY. Underground secondary network controllability is rolled out to all vulnerable network locations. B2G integration with network operations is advanced.	Full Distribution Automation with enhancements for distributed renewables resources integration is the norm in NY. The underground secondary networks become fully controllable and capable of migrating to microgrid technologies with full exploitation of B2G technologies.
4. Energy storage is used to improve economics and reliability	Several distributed storage projects are launched and at least one grid connected large scale storage project is undertaken	Distributed storage becomes accepted practice for distribution system reliability, renewables integration, and peak shaving.	Distributed storage becomes a normal element of utility planning and operations
5. Transmission system reliability and economics are enhanced with smart grid technologies. These are exploited to increase transmission utilization and support renewables integration.	FACTS devices and capacitors for voltage and VAR support and control, and are integrated with state-wide communications and synchrophasor systems. Advanced visualization, stability monitoring, and state estimation are employed to enhance reliability. Dynamic circuit thermal ratings are integrated with NYISO markets and grid operations to enhance transmission capacity in support of renewables. Advanced asset management is demonstrated using integrated smart grid monitoring.	Advanced synthetic inertia and high speed control technologies are used to maintain stability in the face of high renewables penetration. High speed storage devices are used in conjunction with advanced synchrophasor based controls to augment stability. All transmission systems that are congestion bottlenecks have dynamic ratings. Advanced apparatus asset management is the norm.	The grid is fully monitored in real time with an integrated set of advanced monitoring devices. High speed control algorithms exploit all available technologies to enhance reliability and maximize transmission throughput. Advanced maintenance and asset management is fully integrated into utility and regulatory processes.



### 3.4 Federal Smart Grid Funding Opportunities

The NYS Smart Grid Consortium's Technical Plan of the smart grid is mirrored in the categories and requirements of the two DOE funding opportunities. The Consortium has therefore used both sets of criteria as a backdrop against which the current New York State smart grid projects have been assessed. The two funding opportunities are summarized below. The summary of projects being submitted for consideration is provided in the following section ([3.5](#)) and an analysis of how these projects comport with the Smart Grid Technical Plan is provided in section [3.6](#).

#### Smart Grid Investment Grants (SGIG) FOA 58

Smart Grid Investment Grant Program (SGIG; DE-FOA-0000058) has been allocated \$3.375 billion in federal funds. It is designed to make investments that support up to 50% of the installation of devices and technologies for immediate commercial use. Its purpose is to “enable smart grid functions as soon as possible.” All investments must support one or more of the eight smart grid functions defined by the DOE:

1. Information exchange to/from electric utility system through one or a combination of devices and technologies.
2. Information exchange to/from computer or control device.
3. Measure or monitor electricity use (time of day, power quality, source or type of generation).
4. Sense and localize disruptions to sustain reliability.
5. Detect and prevent system security threats.
6. Appliances or machines respond to system automatically without human intervention.





7. Use digital information to operate functions on grid previously electro-mechanical or manual.
8. Digital controls to modify demand and manage operations.

DOE seeks a wide array of projects in all types of situations to maximize the learning from these projects. Projects are expected to support the two-way flow of both electric power and information between electric power companies and electricity consumers. Speeding the integration of devices that achieve interoperability<sup>3</sup> is a key element of projects posed for SGIG consideration.

DOE also expects increased reliability to result, through improved outage detection, equipment maintenance, and asset deferral. Improved environmental protection is also sought through increased integration of renewable, energy efficient-, and lower-carbon technologies. Finally, DOE also seeks to reap economic benefit from SGIG projects, as investment in electric infrastructure leads to new economic opportunities for businesses and the creation or retention of jobs.

DOE requires each SGIG applicant to apply under one of six topic areas:

1. Equipment Manufacturing
2. Customer Systems
3. Advanced Metering Infrastructure
4. Electric Distribution Systems
5. Electric Transmission Systems
6. Integrated and/or Crosscutting Systems

<sup>3</sup> DOE uses the GridWise Architecture Council's definition of 'interoperability' as the capability of two or more networks, systems, devices, applications, or components to share and readily use information securely and effectively with little or no inconvenience to the user.



## Smart Grid Demonstrations (SGDP) FOA 36

Smart Grid Demonstration Projects (SGDP; DE-FOA-0000036) have been allocated \$615 million under the Recovery Act. Like SGIG, projects chosen through DOE's review process will be eligible for financial assistance for up to 50% of eligible project costs. The intent is to fund projects which demonstrate how a suite of existing and emerging smart grid technologies can prove technical, operational and business model feasibility.

SGDP requires applicants to apply under one of two distinct areas, and several domains within each area:

### Regional Smart Grid Demonstrations

- Area, regional, and national coordination regions
- Distributed energy resources technology
- Transmission and distribution (T&D) infrastructure
- Information networks and finance

### Grid-Scale Energy Storage Demonstrations

- Battery Storage for Utility Load Shifting or for Wind Farm Diurnal Operations and Ramping Control
- Frequency Regulation Ancillary Services
- Distributed Energy Storage for Grid Support
- Compressed Air Energy Storage (CAES) Demonstration of Promising Energy Storage Technologies



Projects submitted under the two grant categories will be reviewed in several steps.

- **Merit Review:** The merit review evaluates the adequacy of applicants' technical and management plans. Specific merit review criteria are different under each program and are described fully in the respective program FOAs.
- **Program Policy Factors:** Following the merit review process, the DOE uses a portfolio view of projects to make its final awards. DOE explicitly reserves the right to select projects with lower technical merit to achieve its desired portfolio. Analysis will ensure the portfolio adequately covers:
  - Organizational sizes and types
  - Geographic areas
  - Diverse topic areas
  - Optimal uses of funds
  - Impact on the goals of the Recovery Act
  - Cost share above 50%
- **Selection:** The results of both merit reviews and policy factors screening are provided to the program Selection Officer. The final judgment regarding selected projects rests with this Officer.
- **Negotiation and Award:** Selected projects will be invited into negotiation with DOE, in preparation of a grant contract. Projects that have been selected but awarded less than their requested funding may negotiate an acceptable contract or decline the award.



## 3.5 The New York Smart Grid Portfolio

### Present and Pending Projects

Collaboration – across industry, utility, academic and government sectors and institutions – is a core operating principle for the Consortium. The resulting NYS portfolio of smart grid projects demonstrates that cross-sector diversity and collaboration.

The Consortium portfolio consists of a total of over 86<sup>4</sup> existing, proposed and planned projects, covering virtually all areas of the full smart grid value chain. Projects are categorized below in terms of their sponsors: Investor-Owned Utilities (IOUs), Academic institutions, public Authorities and Government.

As noted above, these projects lay a foundation of smart grid technologies that will enable additional projects in Phase 2 and beyond that require the basic automation technologies and grid enhancements to be in place, as well as exploit the demonstration of consumer benefits to enable widespread roll-out in the state.

**Investor-Owned Utilities** – The New York State Public Service Commission (PSC or Commission) works closely with all NYS IOUs on matters with implications for ratepayers. The Commission has followed closely the evolution of both smart grid technologies and related regulatory issues, and requested all NYS IOUs to file early descriptions of their potential smart grid projects in April 2009.

Upon DOE release of the final FOAs, the Commission required IOUs to file proposed budgets for their anticipated DOE submissions. These filings were submitted on July 2; final PSC guidance to the companies was provided on July 24. A total of 20<sup>5</sup> IOU projects, representing a total investment of \$762 million and the potential creation of roughly 1,228 jobs, are represented within the Consortium portfolio.

<sup>4</sup>This total is comprised of 30 utility & non-utility projects intended for submission to DOE (under both FOA 58 and 36); 29 academic present and proposed projects, and 27 NYSEERDA-funded smart grid projects.

<sup>5</sup> This total does not include the 2 NYISO-led projects.



### Participating Investor-Owned Utilities

Utility	Number of Projects	Total Investment (\$ M)	Job Creation
Central Hudson Gas and Electric	1	17.3	42
Con Edison/Orange and Rockland	13	376.6	388
National Grid	2	270.6	792
New York State Electric & Gas	1	28.4	NA
Rochester Gas & Electric	3	69.1	6
<b>Totals</b>	<b>20<sup>6</sup></b>	<b>\$762</b>	<b>1,228</b>

**Academic, Authorities and Government Projects** – New York State’s many research and academic institutions represent a wealth of expertise in smart grid technologies, through their involvement in grid-related research in demand response, renewable energy technologies and other operational and technical areas. As the Consortium began to coalesce in late 2008, the State’s academic institutions began to catalog their on-going smart grid research. As of July 2009, the total smart grid research underway at the State’s academic institutions was represented by 90 separate projects, totaling roughly \$20.6 million. Of these, 29 are either underway or actively seeking utility partnerships on smart grid applications. These include an array of demonstrations, modeling and other R&D that span many of the same smart grid functions where utility projects are proposed. One of the core strengths of the Consortium is that it provides a forum for information exchange between members, to further accelerate the transfer of knowledge and experience.

In addition, the New York State Energy Research and Development Authority (NYSERDA) has also been a leader in smart grid research, analysis and demonstration. Since 2008, NYSERDA has invested a total of \$10 million in 27 different projects to leverage a total investment of \$120.7 million. NYSERDA’s projects also complement the academic and utility projects and broaden the overall

<sup>6</sup> Does not include the two NYISO-led statewide projects, which represent \$46.4 million in investment and 155 jobs.

portfolio. New York's two power authorities – Long Island Power Authority (LIPA) and New York Power Authority (NYPA) -- have also proposed a total of 7<sup>7</sup> projects for submission to DOE. In combination with the two NYISO projects also applying to DOE, this brings the non-IOU Phase 1 projects to a total of 9. When added to the 20 utility projects and 1 academic project (University of Buffalo's proposed Intermittent and Distributed Generation Demonstration project), a total of 30 Phase 1 projects is reached.

Project Sponsor	Number of Projects	Total Investment (\$ M)	Job Creation
Long Island Power Authority (LIPA)	4	200	137
NYISO	2	46.4	155
New York Power Authority (NYPA)	3	207.5	464
NYSERDA	27	120.7	NA
Academic SG projects (totals)	29	11.6	NA
<b>Totals</b>	<b>65</b>	<b>\$586.2</b>	<b>756</b>

## Project Categorization

To better understand the characteristics of the full Consortium Portfolio, these 30 Phase 1 projects were categorized in several ways. The 22 proposed investment grant projects were assessed against the six topic areas and eight DOE-defined smart grid functions summarized in DOE FOA 58, described in [section 3.3](#). The 8 proposed demonstration projects were similarly characterized according to the categories and 'proof points' defined in FOA 36. All 30 projects were also reviewed against the policy objectives derived from State and DOE priorities, as discussed in section 2. This analysis provided insight into both the attributes of the current portfolio and the opportunities to further accelerate the smart grid transition through subsequent rounds of both private and public investment.

<sup>7</sup> This includes the Hudson Transmission Partners project in which NYPA is participating but does not lead.



**Smart Grid Investment Grant Projects** – In the total portfolio, 22 projects have targeted the first round of the SGIG program. These projects represent \$959.8 million in total project costs, prior to any DOE awards. These 22 projects cover four of the six topic areas in the FOA.

#### Summary of SGIG Projects by Topic Area

Topic Areas	Equipment Manufacturing	Customer Systems	AMI	Electric Distribution Systems	Electric Transmission Systems	Integrated/ Cross-Cutting Systems
# projects	0	1	0	8	6	7
Total investment	--	\$.40	--	\$253.8	\$329.3	\$376.2

When reviewed in terms of the smart grid functions, the 22 proposed Phase 1 projects are spread across five of the 8 functions. Seven of the 22 investment projects will implement technologies and/or devices that ‘sense and localize disruptions to sustain reliability’. Another 8 proposed investment projects focus on the transmission of information between utility systems and computerized ‘smart’ control devices. The absence of projects addressing other functions suggests areas where subsequent projects might be proposed in subsequent SGIG rounds.



### Summary of SGIG Projects by Smart Grid Function

	(1) Info to/from utility through 1 or more devices/ technologies	(2) Information to/ from computer or control device	(3) Monitor electricity use (TOD, power quality, source or type)	(4) Sense & localize disruptions to sustain reliability	(5) Detect & prevent security threats	(6) Appliances or devices respond without human intervention	(7) Use of digital info to operate functions previously manual or electro- mechanical	(8) Use of digital controls to modify demand and manage operations
#	6	2	5	7	0	0	0	2
\$	\$303	\$54	\$69.4	\$324.3	--	--	--	\$209

Finally, the 22 SGIG projects address all three of the overarching policy objectives – Diversification/Sustainability; Grid Enhancement/Reliability and Affordability. Yet 17 of the 22 investment projects focus primarily on enhancing grid reliability.

**Smart Grid Demonstration Projects** – Eight projects totaling \$270.8 million are planned for submittal under the Smart Grid Demonstration program. Six will submit as Regional Smart Grid Demonstrations, with three demonstrating “Area, Regional, and National Coordination Regimes”; one under “Distributed Energy Resources Technology” and two under “Transmission Distribution Infrastructure”.

The current portfolio has no projects demonstrating “Information Networks and Finance” as a primary focus, and contains two demonstrations of Grid-Scale Energy Storage proposed, one under “Distributed Energy Storage for Grid Support” and one under “Demonstration of Promising Energy Storage Technologies”. These eight projects cover only two of the three policy objectives, five projects focused primarily on Grid Enhancement/Reliability and three on Diversification/Sustainability. None of the demonstration projects were focused primarily on Affordability, although several projects will contribute to that objective as a secondary feature.



Overall, then, the 30 projects in the Phase 1 Consortium portfolio focus first on Reliability (22 projects; \$1.07 billion in investment), and then split evenly on both Affordability (4 projects; \$59.4 million) and Sustainability (4 projects; \$101.7 million).

## Portfolio Impact

The 30 projects and \$1.23 billion in investment represented by the current portfolio will further several policy and economic objectives, as mandated by the Recovery Act:

- **Job creation:** A total of 1,706 direct jobs are estimated to be created and/or retained. At the multiplier based on the GridWise Council's job creation study, these jobs will generate another 1,279 indirect jobs, for a total employment impact of 2,985.
- **Stimulus effect:** These projects represent \$1.23 billion in total project costs. The PSC has reviewed and approved investments totaling \$825 million from the six IOUs.
- **Sustainability and Diversification:** A key policy objective to be achieved in the modernization of the smart grid is to reduce the carbon-intensity of electricity generation and use. This objective is furthered by smart grid technologies that facilitate demand response, demand reduction and energy efficiency, and greater integration of intermittent renewable generation. 13.3% of the 30 Phase 1 projects will enhance the integration of renewables, thereby improving both diversification and sustainability.



## 3.6 Smart Grid Roadmap: Building Toward the Future

### Gap Analysis

Analysis of the proposed projects against DOE's criteria highlights areas where the NYS Smart Grid transition has not yet covered all bases. For example, the projects proposed for this Phase 1:

- Cover all six DOE topics and feature an array of smart grid technologies and approaches – from continuing deployment of AMI systems and communications, to system upgrades featuring synchrophasors / PMUs, fiber-optics, sectionalizing switches and many more 'smart' devices.
- Concentrate on the enhancement of transmission and distribution systems – in doing so, IOUs are following PSC guidance to stay within the bounds of current technology – to ensure reliability, emphasize interoperability through the use of devices where technology standards are in place, and minimize demands on the rate base.
- Continue AMI deployment including demonstrations of end-use technologies and/or dynamic pricing. Successful demonstrations in carefully validated pilot projects are essential to gaining public acceptance and statewide roll out.
- Include only one project focused on an area of significant DOE interest; cyber security project.
- Initiate only one new demonstration of grid-scale energy storage, which builds on an existing CAES project initiated by NYSERDA.

Another way of characterizing the progress represented by these Phase 1 projects is provided by the Technical Plan. The summary below compares the current Phase 1 progress against the Ultimate Vision and shows how Phase 2 projects, including proposed regional demonstration projects, will address key gaps.



## Real-Time Customer Costs

### Vision:

- The smart grid's advanced consumer information technologies will provide usage and cost information to customers, and decision support on cost reduction approaches they can take to make their homes and businesses more efficient.

### Phase 1:

- The Phase 1 portfolio starts this transition, with several AMI projects, including in some cases in-home displays that provide consumers with energy usage and cost data.

### Phase 2 projects will:

- Deploy AMI and related devices more fully, in conjunction with dynamic pricing.
- Publish results from pilot projects, including consumer acceptance and endorsement results. This data will be essential in order to enable regulatory guidance beyond what is in place to date.

## Empowered Customers

### Vision:

- Mechanisms to incorporate consumer price elasticity into markets and operations will be in place through NYISO. "Building to Grid" energy management will become an energy saving standard, integrated with NY energy efficiency programs.

### Today, Phase 1 projects make strides in this direction, by:

- Featuring automatic energy saving devices like smart thermostats.
- Demonstrating automation and Building to Grid (B2G) systems in Manhattan with NYC and other landmark buildings.



- Providing advanced demand response and dynamic pricing through the NYISO.
- Integrating Advanced Demand Response with Con Edison underground network operations to enhance reliability.

#### Phase 2 projects will:

- Test additional devices, implement B2G on a larger scale, and ensure the full integration of devices and practices in a seamless system.
- Demonstrate then highlight the economic and occupant benefits of B2G in prominent New York buildings. This will spark a "critical attractor" phenomenon -- where the B2G demonstration systems attract more and more participants.
- Communicate the success of this technology in one of the world's foremost cities, visible to media and financial giants as well as to other city governments, will also spur the adoption of the technologies and protocols nationwide.

### **Distribution, Visibility, and Control**

#### Vision:

- The norm is full Distribution Automation with enhancements for distributed renewables resources.
- The underground secondary networks become fully controllable and capable of migrating to microgrid technologies with full exploitation of B2G technologies.

#### Phase 1 projects propose to:

- Launch several Distribution Automation systems, including advanced smart grid technologies.





- Demonstrate advanced "system of systems" integration for vastly enhanced visibility and control, including distributed renewable resources;
- Pioneer the use of Fault Current Limiters on the underground network.

#### Phase 2:

- Con Edison, manager of the world's largest underground network, is one of the few utilities in the world to maintain a significant Research and development operation including an ongoing underground systems laboratory. Con Edison regularly demonstrates that its purchasing power in this domain can lead manufacturers to bring needed technologies to market based on Con Edison adoption of the technology. Only Con Edison among U.S. utilities can be relied on to advance the state of underground network technologies so critical to the U.S. urban infrastructure.

### Energy Storage

#### Vision:

- Distributed storage becomes a normal element of utility planning and operations.

#### Phase 1:

- Proposed projects will demonstrate several distributed storage projects and at least one grid connected large scale storage project.

#### Phase 2:

- There is a nationwide gap in terms of accepted engineering and operations standards for distributed storage. Regulatory treatment for cost recovery and tariffs on storage is also unaddressed.
- Phase 1 demonstration projects will help establish a basis for the development of the appropriate standards in New York State, as well as contributing to the same for similar environments especially high density metropolitan areas as well as mountainous and rural areas.



## Enhanced, Renewables-Friendly Transmission System

### Vision:

- The grid is fully monitored in real time with an integrated set of advanced monitoring devices.
- High speed control algorithms exploit all available technologies to enhance reliability and maximize transmission throughput.
- Advanced maintenance and asset management is fully integrated into utility and regulatory processes.

### Phase 1 projects propose to:

- Use FACTS devices and capacitors for voltage and VAR support and control, integrated with state-wide communications and synchrophasor systems.
- Use advanced visualization, stability monitoring, and state estimation to enhance reliability.
- Integrate dynamic circuit thermal ratings into markets and grid operations to enhance transmission capacity in support of renewables.
- Demonstrate advanced asset management using integrated smart grid monitoring.

### Phase 2 projects include:

- NYPA dynamic thermal rating demonstration project – this project is intended to increase the amount of renewables integrated into the grid, thereby supporting this objective.
- The Synthetic Inertia project – another Phase 2 project described in the following section – will also increase the ability of the transmission system to accommodate renewables

In summary, the projects proposed in Phase 1 move the NYS Smart Grid Vision forward to a significant degree. At the same time, the areas where further progress



could be made represent opportunities for significant additional projects to be developed. These areas include:

- **Communications:** Projects demonstrating two-way, real-time communications in specific applications are taking important first steps. Yet to ensure a fully-robust, smart *system*, all of these devices and communications tools must be fully interoperable and integrated with the rest of the grid to create a seamless whole.
- **Mircogrids:** No Phase 1 project demonstrates any microgrid applications. However, there are already microgrid installations in place in New York and the integration of these with the proposed Con Edison/Boeing demonstration of advanced grid monitoring and visualization will serve to address this gap.
- **Energy storage:** Additional energy storage projects are needed, particularly to demonstrate the role of plug-in hybrids (PHEVs) as a potential energy storage solution.
- **Building to Grid:** The Phase 1 portfolio contains a single important demonstration of these applications, with the potential to expand into additional customers and building settings. As noted, this project is expected to create a platform which will organically attract more participants as well as spur the deployment of competitors emulating its capabilities.

## Addressing the Gaps

The Consortium's role in accelerating the smart grid transition shows most clearly in the activities undertaken to address these gaps. With a consistent focus on the final form of the fully-implemented Grid, the Consortium's technical advisors have reviewed both present and prospective / possible projects. The intention: to spot and capitalize on potential new demonstrations, bring in new collaborations, add new capabilities, resources, etc., to push forward toward the Smart Grid Vision described in section 3.3.



The following projects stem from this technical cross-fertilization. The Consortium has worked with project proposers to strengthen the project focus, suggest collaborators and/or additional project elements, and move the collective portfolio forward. Of the six potential projects described below, the New York City Building to Grid Demonstration Project demonstrates most fully the role of the Consortium in project development. This role is described more fully in section 3.7 below.

**Regional Investment and Demonstration Projects** – New York has several regional investment and demonstration projects submitted and planned. These projects, while separate applications, will integrate and provide overall smart grid benefits demonstrated via advanced technologies and applications. These include:

- **Regional Synchrophasor, Grid Visibility and Reliability:** This synchrophasor project includes installation of Phasor Measurement Units (PMU) at sites selected for observability and system visibility together with Phasor Data Concentrators (PDC) at participating transmission operators and the NYISO. These applications include: ISO applications such as phasor based direct state estimation, advanced visualization, monitoring and assessment of proximity of voltage collapse, dynamic model calibration to support planning studies, determination of transfer limits, and post mortem disturbance analysis. This is being submitted by NYSERDA as an Investment Grant (FOA 58) application with participation from the NYISO, RPI, and the transmission operators.

Functionalities listed above will be enabled by a fully functional, open, flexible, interoperable and expandable infrastructure of GPS-synchronized PMUs in New York. PMU communications and data processing installations will encompass facilities owned by Consolidated Edison of New York (ConEd)/Orange & Rockland Utilities (O&R), Long Island Power Authority (LIPA), New York Power Authority (NYPA), National Grid, New York State Electric & Gas (NYSEG) /Rochester Electric & Gas (RG&E) and NYISO. Linkages to ISO-NE and PJM will be provided as well in order to enable operators' access to real time information necessary to maintain and ensure wide-area security and reliability.



The existing PMU system will be expanded to include additional measurement units at critical 765kV, 500kV, 345 kV and 230kV buses, upgraded communication links and standard protocols for transmitting data between the individual PMUs and PDCs operated by the Transmission Owners (TOs), and between TO PDCs and NYISO PDC.

- **Regional Smart Grid Communications Backbone:** The New York Statewide Communication Network project as proposed will provide the high-speed digital communication support required for the deployment of future smart grid applications across the New York State transmission grid, as well as upgrading the data and voice communication infrastructure necessary for the reliable and efficient operation of the New York State transmission grid.

Smart grid applications require reliable, high-speed, and secure two-way communications to transfer critical data (e.g., phasor measurement data) from the measurement locations to the nodes where the applications will be deployed, disseminate control signals to transmission substations and generating facilities to be executed, and report necessary actions executed through these control signals or through local closed-loop applications.

The network will provide a reliable and secure fiber-optic backbone interconnecting the New York Independent System Operator (NYISO) with the primary and alternate control centers operated by all New York Transmission Operators (Central Hudson Gas and Electric Corporation; Consolidated Edison Company of New York, Inc.; Long Island Power Authority, Niagara Mohawk Power Corporation (d/b/a National Grid); New York Power Authority, New York State Electric and Gas Corporation, Orange and Rockland Utilities, Inc.; and Rochester Gas and Electric Corporation).

The network will leverage existing rights-of-way and fiber-optic facilities where applicable and will be built out and commissioned as sections. Key activities include detailed design and layout of field equipment



configurations, installation of new fiber-optic cable and associated electronic equipment, and connection of control centers to the main fiber-optic network.

- **Regional Volt-Var Reactive Dispatch and Shunt Capacitors:** The NYISO is proposing the implementation of an advanced OPF based real time voltage-VAR dispatch which will be integrated with the state estimator (including appropriate PMU data when available) and which will act to reduce losses in the state as well as add to protection against voltage collapse. In addition, the NYISO has determined that strategically placed switched shunt capacitors beyond what exists today would provide incremental benefits to the NY grid by reducing power system losses and improve system asset utilization. These capacitor banks, the physical layer of the smart grid, in conjunction with the smart grid would improve the grid energy efficiency in daily operations and controllability during system contingencies. The Transmission Owners have developed a list of the location and cost of the capacitor banks. The OPF based smart grid by itself can accomplish much with existing resources but the addition of additional resources will provide additional muscle to the system and increase the benefits the smart grid can provide. They will be part of the smart grid initiative. These shunt capacitors will be controlled via the regional communications system described above. The regional investment grant application is for the acquisition and installation of the shunt capacitors by the transmission owners and their integration with the NYISO OPF.
- **Regional Dynamic Thermal Circuit Ratings and Grid/Market Operations:** The New York Power Authority and the NYISO will be submitting a regional demonstration project for the implementation of Dynamic Thermal Circuit Ratings (DTCR) and the integration of these with the NYISO grid operations and markets. NYPA and EPRI will select and implement monitoring equipment such as sag monitoring and remote temperature measurements which will be utilized in a thermal ratings calculation system at NYPA. These ratings will then be used by the NYISO





in the real time monitoring, contingency analysis, dispatch, and day ahead market applications. As upstate New York already experiences transmission congestion that forces the curtailment of wind production today and more of this is expected as wind resources increase, the economics of allowing increased thermal ratings when wind speeds are high (wind cooling allows increased circuit ratings) will be significant. The project will demonstrate the efficacy and economic benefits of this technique.

- **Building to Grid and Market Integration:** New York City, NYPA, NYSERDA, and the NYISO are preparing a demonstration project of advanced Building to Grid systems deployment and integration with NYISO markets and operations. The B2G system will include dynamically adaptive models of building systems performance and energy utilization with co-optimization over time used to maximize demand response and dynamic pricing benefits. In addition to New York City, one or more commercial real estate developers may also participate. The NYISO will support this project with desirable adaptations to the demand response market operations and publication of appropriate dynamic pricing signals in conjunction with NYPA. The B2G system will also be used to provide locational demand response potential to Con Edison so that localized network problems can be alleviated in the short term via surgical demand response.
- **Advanced Wind Turbine Synthetic Inertia Demonstration and Validation:** The NYISO and General Electric are exploring the possibility of a demonstration project that will validate the new "WindInertia" control capability of advanced GE wind turbines and inverters which can provide synthetic system inertial frequency response. This technology helps mitigate decreasing system inertia under high renewable penetration and enhances system stability by providing additional controlled frequency response. The validation of the technology would include use of the regional synchrophasor system to obtain high speed data and response tracking.



## 3.7 Project Manager Support

### Technical Assistance: Project Review

As each utility proposer has summarized its anticipated DOE applications, the Consortium team has examined how those projects fit within, extend and support the overall Smart Grid Vision and road map. As multiple proposers employ similar devices (e.g., PMUs) in different settings, the opportunity to learn from the wider base of experience also grows. The project management team has maintained a master list of smart grid projects from proposers in all sectors, categorizing those projects by objectives, functions, size/budget, and in other ways to allow the categorization of the overall NYS portfolio. As changes have occurred in the portfolio, as projects have been merged, dropped, added or otherwise modified, the project management team has incorporated these changes.

### Continuing Development of Significant Demonstration Projects

These Phase 1 projects provide the foundation and starting point for the true 'value added' that this collaboration represents. The synergies, cross-fertilization and collective experience represented by these projects provide a wealth of resources that would not be available much less reaped in the absence of the Consortium.

The value of the effort is already visible in the six demonstration projects described previously. In particular, the New York State Building to Grid project exemplifies the role of and value-added by the team. Using the gap analysis described earlier, the team identified the need for a significant demonstration of a) building-to-grid technologies, b) dynamic pricing, in a setting that c) takes advantages of NYS's unique characteristics while d) providing the opportunity for national applicability.

In pursuit of this project, the team has sought out the interest of potential collaborators, brought the participants together around a project design, proposed roles and resources for contribution by the parties, and in general played a



facilitative role in bringing the project to fruition. The result will be a project that brings together a wide array of players to showcase a critical dimension of the SG in a setting with unique challenges and opportunities.

This same technical assistance role will continue to be provided as the list of projects evolves. In particular, the team will continue to facilitate cross-connections between other categories of Consortium participants:

- Linking the current 90+ academic projects with appropriate utility partners.
- Assisting academic proposers to identify past, present or pending utility experience as they develop future projects.
- Ensuring that industry partners are tied into utility, authority and government projects to the maximum extent possible.



## 4 Ongoing development of the New York State Smart Grid

### 4.1 Roadmap for the Future

The launch of the Consortium and filing of Smart Grid Stimulus Grant proposals has provided significant momentum for development of the New York smart grid. But there is significant start-up work ahead to lay the foundation for future success. Section 3 of this report outlines these activities in a Roadmap for the Future.

### 4.2 Strategic Mapping

The Strategic Vision of the New York smart grid needs to be translated into a useful management tool through the creation of a Strategic Mapping process. The Strategic Map is intended to provide a holistic view of smart grid progress at a glance. Like a metrics dashboard, it will help the Consortium steer and pace the development of the smart grid. It is intended to focus attention where it is required, but is not a substitute for the detailed analysis and review of working groups. It will be used to help prioritize future smart grid research and deployment, measure progress toward completion of the smart grid and facilitate smart grid communication with stakeholders.



## Smart Grid Strategic Mapping

		Value Chain										
		Generation		Transmission		Distribution		Consumption				
SMART GRID LAYERS	Standards											
	Security											
	Advanced Systems & Operations											
	Advanced Sensors & Controls											
	Integrated Communication Networks											
	Markets	Renewable – Variables		Regional / Transmission Organizations	NYISO	Pricing Signals		Industrial	AMI	Network Automation		
		Storage				Demand Response				DR/Smart Devices	DG	Storage
		Renewable – Non-Variables				Pricing Signals		Commercial	AMI	Network Automation		
		Non-renewable				Demand Response				DR/Smart Devices	DG	Storage
						Pricing Signals		Residential	AMI	Network Automation		
						Demand Response				DR/Smart Devices	DG	Storage

In the prototype Strategic Map above, the layers of the smart grid are identified on the left side, starting with Markets at the bottom to Standards at the top. The value chain is labeled across the top from Generation to Transmission to Distribution and Consumption. The dimensions of the key components of the smart grid are identified and situated appropriately within this matrix.

Since this taxonomy will be crucial to the use of the Strategic Map, the first step of the process will be to refine it with the appropriate Consortium Working Groups. Once this is complete, information about the status of the smart grid needs to be collected for all components within the matrix. Based on a combination of quantitative and qualitative metrics, components of the Strategic Map will be filled in with appropriate colors and shades to indicate status at a glance.



The Strategic Map will be completed based on the current status of the smart grid in New York and a second version will depict how it will change based on the approved stimulus projects. Working groups will be convened to review these findings and then recommend priorities for the future in terms of research and deployment. The Strategic Map will also provide important input for the Annual update of the Strategic Smart Grid Vision.

### 4.3 Metrics and Allocation Process

***DOE Reporting Liaison*** – Once the stimulus proposals are awarded, a process for combining and reporting milestones and metrics across New York State projects needs to be established. Grant recipients are required to negotiate their metrics with the DOE. The Consortium should have simultaneous discussions with recipients to ensure a smooth collection and data validation process.

***Optimize / Coordinate State / Public Funds*** – One of the first uses of Strategic Mapping will be to identify significant gaps that remain after stimulus projects are in place. Working groups supported by staff should identify and prioritize potential smart grid deployment projects where state/public funding can be leveraged to achieve the optimal impact. Recommendations should be formulated and forwarded to the Consortium Board for approval. Project metrics will be developed to report progress on an ongoing basis.

***Identify / Facilitate Funding Opportunities*** – Interactions with federal, regional and state authorities by staff and members of the Consortium will be a vital source of information to identify funding opportunities that can accelerate smart grid progress. Relationships developed in the reporting process will be invaluable in facilitating these funding opportunities and are an important function of the Consortium.





## 4.4 Deployment of Technical Project Support

**Technical Support** – The smart grid is emerging over time. Many of the technologies that will be installed and tested in the investment grants and demonstrations may not have been deployed at a full scale level in New York State. The Consortium will provide technical support to its members on an as needed basis. This could include seminars on specific topics; white papers, and specific direct support to members by the Consortium staff. The Consortium will facilitate the dissemination, in particular any evaluations, of specific projects or activities and may also provide additional materials such as case studies and best practices.

**Facilitate Coordination and Collaboration** – The Consortium will facilitate coordination and collaboration among members. This will be partially facilitated by the working groups as well as the technical support discussed in the previous section. The Consortium will also identify possible joint opportunities for research across members.

## 4.5 Nexus Development – R&D

**Define and Dimension the Smart Grid Technology Nexus** – All technology assets, facilities, projects and proposals that comprise the NYS Smart Grid Nexus need to be identified and assessed. NYSTAR has provided a good start by cataloging the relevant academic research projects. Other major elements to be dimensioned include the activities at Brookhaven National Laboratory, the proposed Innovation Center (AERTC & IBM) and the activities of other New York Energy Frontier Research Centers (Columbia, Cornell and GE).

**Assess Areas of Strength** – Based on the definition of the Nexus, an appropriate working group should assess and identify areas of strength. Among those to be considered are the four which have already been identified - Power Electronics, Adaptive Materials, Utility Scale Energy Storage and Systems / Sensors / Cyber Security. Areas of strength can then be compared to the Strategic Map to identify fit and gaps. These areas should also be assessed relative to competing resources in other states across the nation.



***Position the Nexus*** – Based on the definition and assessment of gaps and relative strengths, the Consortium can develop the appropriate positioning of the Nexus. This may include a charter, operating principles, organization structure, governance and communications process. The objective is to position the Nexus to effectively harness and focus the research talent and resources on the areas with the greatest impact. Congress to this point is balking at the DOE suggestion to create eight Innovation Hubs in 2010. If at some point the Administration prevails, the Nexus should be well positioned to receive the smart grid designation.

***Target and Approve CLEAR Funds*** – With a set of priorities, structure and game plan in place, funding will be required to help the Nexus get traction. It is envisioned that a plan will be created to deploy some portion of the \$17 million RGGI funding targeted for CLEAR Centers (education). This plan would be taken to the Consortium Board and NYSERDA for approval.

## 4.6 Formalize the Consortium Structure

***Structure*** – The incorporation of the Consortium as a 501 (c) 4 included basic by-laws and charter which need to be fully implemented through Board actions. Examples include formal approval of the Operating Principles, enlargement of the Board, creation of membership categories, approval of a budget and the establishment of administrative operations.

- **Approve Operating Principles:** The Board and current members of the Consortium need to formally approve the Operating Principles. This should be an agenda item for their next respective meeting.
- **Enlarge Board:** The Executive Committee is currently constituted as the Board. It is expected that this group will be enlarged to include members from each area of the Consortium. A nomination committee as well as other Board governance procedures will need to be established.
- **Formalize and Expand Membership:** The membership process needs to be formalized. It is envisioned that there will be two or more categories of



members and that annual dues will be assessed based on these categories. Dues need to be set to provide for operations for the balance of 2009 and 2010. There are potential members, such as representatives of end-users who need to be recruited to the consortium. Targeting these additional members and the solicitation process will be important to ensure the Consortium has representation from across the value chain.

- **Create an Operating Plan for 2009/10:** An operating plan needs to be created which reflects the priorities, activities, deliverables and milestones of the Consortium.
- **Establish Administrative Support:** Transition administration is currently being provided on an ad hoc basis by NYSERDA and NYSTAR. A plan for the size, scope and location of administrative support needs to be finalized and the cost estimated.
- **Approve a Budget:** The Board needs to adopt a final budget which covers all the items outlined above and delegates the appropriate authority to collect and disperse funds.



## 5 Conclusion

The shared commitment of the New York State Smart Grid Consortium, combined with the expertise, capabilities and resources of its members, positions New York State as a leader to successfully achieve its Smart Grid Vision. The anticipated DOE Stimulus Awards are a unique opportunity to accelerate the progress of smart grid deployment. The formalization of the Consortium through governance, Nexus development, communications and process will enhance its ability to successfully and collaboratively lead this important transformation. Governor Paterson hailed the NYS Smart Grid Consortium as “the holistic model for public/private partnerships that we need to secure our sustainable energy future.” The time is now to deliver on that promise.



## 6 Appendix

### 6.1 Complete list of NYSERDA projects

ID #	Project Title	Partners	Total Cost (\$M)
1.	Compressed Air Energy Storage (CAES)	NYSEG	60.0
2.	Project Hydra Demonstration	ConEd	37.5
3.	Smart Grid Pilot Project	O&R	4.4
4.	Dispatchable Green Energy Integration with Intermittant Wind Resources	Brookfield Renewable Power	3.0
5.	Use of Demand Response to Support NYS Transmission and Distribution Circuits	Innoventive Power LLC	2.5
6.	Real-Time Applications of Phasor Measurement Units (PMU) for Visualization, Reactive Power Monitoring and Voltage Stability Protection	EPRI	1.5
7.	Interconnection of a 20 MW Flywheel Regulation Plant to a High Voltage Grid	Beacon Power Corp	4.2
8.	NY State Phasor Measurement Network	NYISO	0.8
9.	Utilization of Microgrids for Reliability Improvement and System Reinforcement	Central Hudson G&E	0.8
10.	Prevention of Occurance of Major Catastrophic Events	V&R Energy Systems Research	1.3
11.	Fast Fault Screening Tool for Real-Time Transient Stability Assessment	EPRI	0.5
12.	Commercial and Regulatory Models for Non-Utility Transmission Infrastructure	SMRT Line, LLC	0.4



ID #	Project Title	Partners	Total Cost (\$M)
13.	Surface-Textured High-Voltage Insulators with Superhydrophobicity	Clarkson University	0.4
14.	Compressed Air Energy Storage (CAES) Engineering Study	NYSEG	0.4
15.	Local Distribution Power Factor Correction	Power Factor Correction LLC	0.2
16.	Transmission Grid Operation Risk Assessment using Advanced Sensor Technologies	EPRI	0.3
17.	Analysis: Near-Term Impact on NYS Power System of Proposed GHG Policies	GE	0.3
18.	Conceptual Design and Assessment for a Green Urban Network	EPRI	0.3
19.	Reliability-Based Design Methodology for Electric Power Distribution Systems	Clarkson University	0.3
20.	Engineering Assessment of T&D Losses	EPRI	0.3
21.	Installing Flexible Alternating Current Transmission System (FACTS) Devices	JWD Consulting, Inc.	0.4
22.	NYISO Demand Response Capability Assessment	Alcoa, Inc.	0.2
23.	Voltage Dispatch & Pricing in Support of Efficient Real Power Dispatch	New Electricity Transmission Software Solutions Inc.	0.2
24.	Effective Approaches to Deployment of Distributed Generation as T&D Resource	Pace Law School Energy Project	0.2
25.	Microgrids: Benefits of Small Scale Electricity Networks in NYS	Columbia University	0.2
26.	NY Presbyterian Hospital Ground Fault Protector Demonstration	NY Presbyterian Hospital	0.2
27.	Public Ownership of Energy Storage Systems in New York State	6-Nines Power LLC	0.1
Total			\$120.70



## 6.2 Complete list of NYSTAR Projects

ID #	Project Title	Sponsor	Potential Partners	Status	Total Cost (\$M)
1.	Large-Scale Energy Storage for Grid Support	CCNY	NYISO, ConEd; any generator	Funded & underway; seeking utility partner	
2.	Demonstration: Stationary 25KWh Ni-Zn-flow Battery	CCNY Energy Institute	any generator	Proposed; FOA 36 application	4.5
3.	Electrochemical Energy Storage for Grid Application	CCNY Energy Institute	any generator	Funded & underway; seeking utility partner	1.5
4.	Metal Particulate Regeneration for Energy Storage	CCNY	any generator	Funded	0.1
5.	Stability of Complex Networks	Hofstra	NYISO	Funded & underway	0.5
6.	Solar Carport: PV with PHEVs	NYIT	ConEd (w/ V2G project)	Funded; seeking utility partner	0.3
7.	Green Campus	NYIT	potential partner in NYS SGC B2G demo	Funded and underway	0.1
8.	Maximum Solar Penetration in Secondary Networks	NYU Poly	ConEd; any wires co	Proposed	1.3
9.	Universal Controller for Interconnection of DG with Utility Lines at Customer-Level Voltages	NYU Poly	ConEd	Funded & underway	0.2
10.	Evaluation of 3-Phase Bolted Short-Circuits on Distr Networks with Customers' Distributed Generators	NYU Poly	ConEd	Completed; results available	0.2
11.	Fault Analysis on Distribution Networks Having Static Converter Systems	NYU Poly	ConEd	Completed; results available	0.2
12.	Phase-Angle as an Additional Indicator of Imminent Voltage Collapse in Electric	NYU Poly	ConEd; LIPA, N Grid	Completed; results available	0.2





ID #	Project Title	Sponsor	Potential Partners	Status	Total Cost (\$M)
	Transmission and Distribution Systems				
13.	Design and Validation of a Real-Time Thermal Rating System for Distribution Cable Installations	NYU Poly	any utility with underground distribution	Proposed	
14.	Development of New Toroidal Distribution Transformers	NYU Poly	any capacitor bank projects	Funded	1.2
15.	Power Quality with Non-Linear Loads	NYU Poly	N Grid, BNL	Completed; results available	0.1
16.	Load Model of Secondary Network Distribution Buses Under Varying Voltage Conditions	NYU Poly	ConEd, LIPA, NYISO	Completed; results available	0.1
17.	Phasor Data Measurement Research	RPI	N Grid, NYISO	Funded?	
18.	Scalable and Flat Controls for Reliable Power Grid Operation with High Renewables Penetration	RPI	several universities; NYISO	Funded & underway	
19.	Advanced Reactive Power Dispatch Concepts & Algorithms/ On-Line FACTS Controller Training Simulator	RPI	EPRI; Korean Electric Power Research Institute	Funded & underway	
20.	Optimization of Electric Power Grid Operation & Security	SUNY-SB	LIPA, ConEd	Funded	
21.	Upgrade of Required Electric Grid Reliability Calculations	SUNY-SB	NYISO	Funded?	
22.	Low-Cost Universal Energy-Harvesting Sensor Platform for Infrastructure & Environmental Monitoring	SUNY-SB	N Grid	Funded?	
23.	Study of Stochastic System in Energy Projects	SUNY-SB	LIPA, NYISO	Funded?	
24.	Substation of the Future	Univ-Buffalo	Grid; NYPA	Proposed; FOA 36 application	
25.	Neural Network Pattern Recognition Schemes	Univ-Buffalo		Funded &	0.2



ID #	Project Title	Sponsor	Potential Partners	Status	Total Cost (\$M)
	for Identification and Location of Faults in HV Power Transmission Lines			underway	
26.	Stand-Alone System for Fully-Integrated Monitoring of Gas-Insulated Power Transmissions and Distribution Components	Univ-Buffalo		Funded & underway	0.1
27.	High-Reliability SiC Power Switch Module Packaging	Univ-Buffalo		Funded & underway	0.8
28.	Impact of PHEVs on the Utility Grid	Univ-Buffalo	N Grid	Completed	0.0
29..	Applying Chip Level Power Grid Design to the Smart Grid	Univ-Rochester	NYISO, ConEd; any generator	Proposed	0.4
Total					\$11.60

